

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-314861

(43)Date of publication of application : 09.12.1997

(51)Int.Cl.

B41J 2/175  
B41J 2/05

(21)Application number : 08-141323

(71)Applicant : CANON INC

(22)Date of filing : 04.06.1996

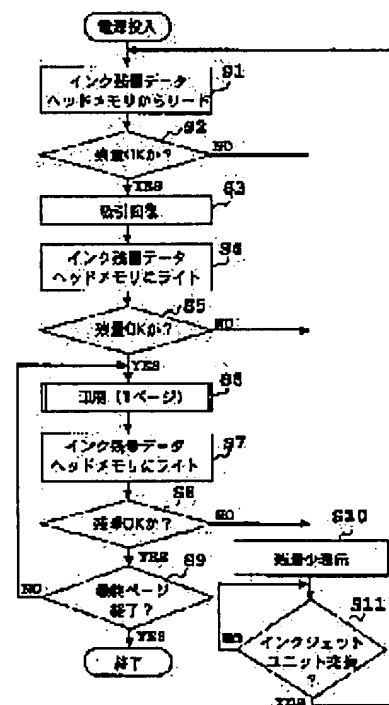
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## (54) INK JET RECORDING DEVICE AND INK JET UNIT

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To constitute a residual ink amount detecting system for an ink jet recording device simply and at a low cost.

**SOLUTION:** Memory for storing data relative to a residual ink amount is provided in an ink jet head to read residual ink data from the memory (step S1) when a power supply for the device is turned on, thereby using the data for detecting the residual ink amount. Further, the ink amount consumed for ink suction resumption (step S1) and every printing (step S6) is subtracted from the value indicated by the residual ink amount data each time the ink suction resumption and the printing are performed. The subtraction results are used as new residual ink amount data and at the same time, this data is written to the memory in the ink jet head (steps S4, S7). When the residual ink amount data indicates a value below a specified level, the device indicates that the residual ink amount is at a low level (step S10).



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[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

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[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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**CLAIMS**

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[Claim(s)]

[Claim 1] In the ink jet recording device which records by breathing out ink from said head using the ink jet unit which formed in one the ink tank which stored the ink supplied to a head with memory, and this head A read/write means to perform the writing or reading of data about ink consumption to the memory which a head has, The ink jet recording device characterized by having a residue detection means to detect the ink residue in an ink tank, based on the data about the ink consumption which this read/write means read from said memory.

[Claim 2] It is the ink jet recording device according to claim 1 characterized by for the data about said ink consumption being a count of the ink regurgitation, and the count of suction recovery, and said read/write means writing the accumulation value of said count of the ink regurgitation, and the count of suction recovery in said memory.

[Claim 3] Said read/write means is an ink jet recording device according to claim 1 or 2 characterized by performing the writing to said memory whenever record actuation or suction recovery of the specified quantity is completed.

[Claim 4] Said ink jet recording device is an ink jet recording device according to claim 1 to 3 characterized by having further an information means to report a purport with few residues when said residue detection means detects that an ink residue is below the specified quantity.

[Claim 5] Said memory is an ink jet recording device according to claim 1 to 4 characterized by being what shared for storing of other information.

[Claim 6] Said head is an ink jet recording device according to claim 1 to 5 characterized by making ink produce air bubbles using heat energy, and carrying out the regurgitation of the ink based on generation of these air bubbles.

[Claim 7] The ink jet unit characterized by storing the data about ink consumption with which writing or reading is performed when it is used with an ink jet recording device and used for said memory with an ink jet recording device in the ink jet unit which formed in one the ink tank which stored the ink supplied to a head with memory, and this head.

[Claim 8] The data about said ink consumption are an ink jet unit according to claim 7 characterized by being the accumulation value of the count of the ink regurgitation, and the count of suction recovery.

[Claim 9] Said head is an ink jet unit according to claim 7 or 8 characterized by making ink produce air bubbles using heat energy, and carrying out the regurgitation of the ink based on generation of these air bubbles.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the configuration for detecting the ink residue in the ink tank for storing in detail the ink supplied to an ink jet head about an ink jet recording apparatus and an ink jet head.

[0002]

[Description of the Prior Art] The configuration for the ink residue detection known better than before detects the existence of inter-electrode ink by inserting two needles for electrodes into an ink tank, and calculating these two inter-electrode ink resistance.

[0003] Drawing 1 is the mimetic diagram showing the conventional example. In drawing, 32 shows an ink tank, the absorber is absorbed by the interior, and the absorber is filled up with ink 31. One pair of electrodes 33 pierce through the member which makes the case of the ink tank 32, and are prepared. Lead wire connects with each electrode 33, thereby, by the predetermined power source in the body of a recording device, a current detection configuration, etc., the current (or electrical potential difference) between A which impresses a constant voltage (or constant current) to inter-electrode [ which is shown by A and B among drawing ], and is then produced, and B is detected, ink resistance is got to know, and, finally an ink residue is calculated by it.

[0004] Drawing 2 is drawing showing the equal circuit of the ink residue detection configuration concerning the conventional example mentioned above. Resistance  $R_i$  which shows the resistance according to the amount of ink among the electrodes A and B to which a predetermined electrical potential difference is impressed according to a power source 41 It exists and is the resistance  $R_i$ . An ink residue can be judged with a value.

[0005]

[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional example, since the resistance of the ink which exists in inter-electrode is measured, when the resistance changes with classes of ink, dispersion may be produced and the various constraint on the ink tank assembly resulting from inserting the pin for electrodes in the residue obtained as a result of measurement may arise. Furthermore, the resistance measurement circuit for calculating resistance might be needed, it might combine with the configuration about a pin, and cost might become high.

[0006] This invention is made in view of the above-mentioned trouble in ink residue detection, and it aims at offering the ink jet recording apparatus and ink jet unit which the place made into the purpose is a simple configuration, and enable ink residue detection of low cost.

[0007]

[Means for Solving the Problem] Therefore, the ink jet unit which formed in one the ink tank which stored the ink supplied to a head with memory and this head in this invention is used. In the ink jet recording device which records by breathing out ink from said head A read/write means to perform the writing or reading of data about ink consumption to the memory which a head has, This read/write means is characterized by having a residue detection means to detect the ink residue in an ink tank, based on the data about the ink consumption read from said memory.

[0008] Moreover, it is characterized by storing the data about ink consumption with which it is

used with an ink jet recording device, and writing or reading is performed in the ink jet unit which formed in one the ink tank which stored the ink supplied to a head with memory, and this head when used for said memory with an ink jet recording device.

[0009] Since the data about ink consumption of the count of the regurgitation etc. are stored in the memory which a head has according to the above configuration, the information about the residue of the ink in an ink tank can be acquired by reading this data.

[0010]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained to a detail with reference to a drawing.

[0011] Drawing 3 is the mimetic diagram showing the internal configuration of the ink jet unit concerning 1 operation gestalt of this invention.

[0012] As shown in drawing, an ink jet unit forms a head 10 and the ink tank 14 in one, and it is equipped with this unit free [ attachment and detachment ] to carriage (un-illustrating). In drawing, 11 is a memory device, for example, EEPROM can constitute it. 12 is the PCB substrate with which the memory device 11 was attached, and the silicon substrate in which the exoergic resistor (un-illustrating) of plurality [ 13 ] was arranged corresponding to the number of ink deliveries, and the silicon substrate 13 and the PCB substrate 12 are electrically connected by wire bonding. 15 is a terminal for being prepared in the edge of the PCB substrate 12 and performing electrical installation by the side of a head and the body of equipment, and connects with the connector prepared on carriage with wearing on the carriage of an ink jet unit. A head 10 is constituted by each above element. On the other hand, the ink tank 14 stores the ink supplied to a head 10.

[0013] In the above configuration, the number of the driving pulses which show the count of the ink regurgitation, and the count of suction recovery are written in the memory device 11 in a head 10. That is, accumulation values, such as the number of driving pulses about the amount of ink consumed with a head 10, are memorized. Thereby, the ink residue of the ink tank 14 can be known.

[0014] In addition, although a memory device 11 may newly be formed in ink residue detection, the null part of the memory with which the head equips bit amendment from the first, for example can also be used for it, and, thereby, it can control further the increment in the cost for ink residue detection.

[0015] Drawing 4 is a flow chart which shows processing of reading/writing to the memory device 11 of the data about ink residues, such as record (printing) actuation and an above-mentioned driving pulse accompanying the actuation.

[0016] With this operation gestalt, processing is started by switching on a power source, and while storing in RAM of reading processing of the data in the memory 11 of the ink jet unit with which it is equipped at step S1, it asks for the data in which the current ink residue in the ink tank 14 is shown based on the read data. That is, the number of driving pulses read in memory 11 and the count of suction recovery action can be converted into the amount of ink consumed by them, and an ink residue can be known by subtracting from the value which shows the amount of ink of the beginning of the ink tank beforehand known in this value. Next, in step S2, it judges whether it is the following from a fixed value with the ink residue calculated the account of a top.

[0017] Here, when an ink residue judges more than as constant value, suction recovery action is performed at step S3, the count which is step S4 and was performed to the count of suction recovery of accumulation at step S3 is added, and the result is written in the memory 11 of a head. That is, since fixed amount ink will be consumed if suction recovery is performed, while

updating the residue data loaded in predetermined RAM of a control section, it performs writing the data in the memory 11 in a head. Next, based on the residue data updated at step S5, the same ink residue as step S2 is checked.

[0018] If it judges that it is the amount which an ink residue can still print at step S5, while printing 1 page at step S6, the number of driving pulses in the printing will be counted. And at step S7, while updating ink residue data by adding the number of driving pulses counted for 1 page to the accumulation pulse number in which it is stored in RAM, these data are written in the memory 11 in a head. In addition, specifically, the count of the number of driving pulses shown above can count the "on-" data of drive data with a predetermined counter. Moreover, similarly, whenever the count of recovery also processes, it is countable by incrementing the contents of the predetermined counter. Next, this procedure is ended when record of the last page was completed in step S9, and it judged whether it was record termination, when the same residue check as steps S2 and S5 was performed and the ink residue had not yet decreased at step S8, the processing same to processing of step S6 as return is repeated when having not ended, and it is judged that it ended.

[0019] On the other hand, by each of steps S2, S5, and S8, when a residue judges that there are few residues below with a predetermined value, in step S10, it stands by displaying a purport with few ink residues by the predetermined display of a printer, and being exchanged in an ink jet unit at step S11. Detection of having been equipped with a new ink jet unit carries out return and processing beyond step S1 mentioned above to processing of step S1.

[0020] In addition, although explanation of the mechanical configuration of a printer etc. was omitted, of course in explanation of the above operation gestalt about the configuration except having explained above, a well-known thing can be used.

[0021] Moreover, although memory 11 was formed in the substrate 12 by external, you may make it form in a silicon substrate in the above-mentioned operation gestalt in the process same with forming an exoergic resistor, an electrode, etc. in a silicon substrate 13, for example.

[0022] (in addition to this) In addition, especially this invention is equipped with means (for example, an electric thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used also in an ink jet recording method in order to make the ink regurgitation perform, and brings about the effectiveness which was excellent in the recording head of the method which makes the change of state of ink occur with said heat energy, and the recording device. It is because the densification of record and highly minute-ization can be attained according to this method.

[0023] About the typical configuration and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 specification and the 4740796 specification, for example is desirable. Although this method is applicable to both the so-called mold on demand and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the case of the mold on demand By impressing at least one driving signal which gives the rapid temperature rise which supports recording information and exceeds nucleate boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the air bubbles in the liquid (ink) corresponding to this driving signal can be formed by one to one as a result, it is effective. A liquid (ink) is made to breathe out through opening for regurgitation by growth of these air bubbles, and contraction, and at least one drop is formed. If this driving signal is made into the shape of a pulse form, since growth contraction of air bubbles will be performed appropriately

instancy, the regurgitation of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable. As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed.

[0024] As a configuration of a recording head, the configuration using the U.S. Pat. No. 4558333 specification and U.S. Pat. No. 4459600 specification which indicate the configuration arranged to the field to which the heat operation section other than the combination configuration (a straight-line-like liquid flow channel or right-angle liquid flow channel) of a delivery which is indicated by each above-mentioned specification, a liquid route, and an electric thermal-conversion object is crooked is also included in this invention. In addition, the effectiveness of this invention is effective also as a configuration based on JP,59-138461,A which indicates the configuration whose puncturing which absorbs the pressure wave of JP,59-123670,A which indicates the configuration which uses a common slit as the discharge part of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to a discharge part. Namely, no matter the gestalt of a recording head may be what thing, it is because it can record now efficiently certainly according to this invention.

[0025] Furthermore, this invention is effectively applicable also to the recording head of the full line type which has the die length corresponding to the maximum width of the record medium which can record a recording device. As such a recording head, any of the configuration which fills the die length with the combination of two or more recording heads, and the configuration as one recording head formed in one are sufficient.

[0026] In addition, this invention is effective also when the thing of a serial type like an upper example also uses the recording head fixed to the body of equipment, the recording head exchangeable chip type to which the electric connection with the body of equipment and supply of the ink from the body of equipment are attained by the body of equipment being equipped, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one.

[0027] Moreover, as a configuration of the recording device of this invention, since the effectiveness of this invention can be stabilized further, it is desirable to add the regurgitation recovery means of a recording head, a preliminary auxiliary means, etc. If these are mentioned concretely, a preheating means to heat using the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head, and a reserve regurgitation means to perform the regurgitation different from record can be mentioned.

[0028] Moreover, although only one piece was prepared also about the class thru/or the number of a recording head carried, for example corresponding to monochromatic ink, corresponding to two or more ink which differs in an others and record color or concentration, more than one may be prepared the number of pieces. That is, although not only the recording mode of only mainstream colors, such as black, but a recording head may be constituted in one as a recording mode of a recording device or the paddle gap by two or more combination is sufficient, for example, this invention is very effective also in equipment equipped with at least one of each of the full color recording mode by the double color color of a different color, or color mixture.

[0029] Furthermore, in addition, in this invention example explained above, although ink is explained as a liquid It is ink solidified less than [ a room temperature or it ], and what is

softened or liquefied at a room temperature may be used. Or by the ink jet method, since what carries out temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stabilization regurgitation range about the viscosity of ink, ink may use what makes the shape of liquid at the time of use record signal grant. In addition, in order to prevent the temperature up by heat energy positively because you make it use it as energy of the change of state from a solid condition to the liquid condition of ink, or in order to prevent evaporation of ink, the ink which solidifies in the state of neglect and is liquefied with heating may be used. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied also when using the ink of the property which will not be liquefied without grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when reaching a record medium. The ink in such a case is good for a porosity sheet crevice or a through tube which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the condition of having been held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0030] Furthermore, in addition, as a gestalt of this invention ink jet recording device, although used as an image printing terminal of information management systems, such as a computer, the gestalt of the reproducing unit combined with others, a reader, etc. and the facsimile apparatus which has a transceiver function further may be taken.

[0031]

[Effect of the Invention] Since the data about ink consumption of the count of the regurgitation etc. are stored in the memory which a head has according to this invention so that clearly from the above explanation, the information about the residue of the ink in an ink tank can be acquired by reading this data.

[0032] Consequently, ink residue detection can be performed with a simple and low cost configuration.

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## TECHNICAL FIELD

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[Field of the Invention] This invention relates to the configuration for detecting the ink residue in the ink tank for storing in detail the ink supplied to an ink jet head about an ink jet recording apparatus and an ink jet head.

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## PRIOR ART

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[Description of the Prior Art] The configuration for the ink residue detection known better than before detects the existence of inter-electrode ink by inserting two needles for electrodes into an ink tank, and calculating these two inter-electrode ink resistance.

[0003] Drawing 1 is the mimetic diagram showing the conventional example. In drawing, 32 shows an ink tank, the absorber is absorbed by the interior, and the absorber is filled up with ink 31. One pair of electrodes 33 pierce through the member which makes the case of the ink tank 32, and are prepared. Lead wire connects with each electrode 33, thereby, by the predetermined



power source in the body of a recording device, a current detection configuration, etc., the current (or electrical potential difference) between A which impresses a constant voltage (or constant current) to inter-electrode [ which is shown by A and B among drawing ], and is then produced, and B is detected, ink resistance is got to know, and, finally an ink residue is calculated by it.

[0004] Drawing 2 is drawing showing the equal circuit of the ink residue detection configuration concerning the conventional example mentioned above. Resistance  $R_i$  which shows the resistance according to the amount of ink among the electrodes A and B to which a predetermined electrical potential difference is impressed according to a power source 41 It exists and is the resistance  $R_i$ . An ink residue can be judged with a value.

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## EFFECT OF THE INVENTION

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[Effect of the Invention] Since the data about ink consumption of the count of the regurgitation etc. are stored in the memory which a head has according to this invention so that clearly from the above explanation, the information about the residue of the ink in an ink tank can be acquired by reading this data.

[0032] Consequently, ink residue detection can be performed with a simple and low cost configuration.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional example, since the resistance of the ink which exists in inter-electrode is measured, when the resistance changes with classes of ink, dispersion may be produced and the various constraint on the ink tank assembly resulting from inserting the pin for electrodes in the residue obtained as a result of measurement may arise. Furthermore, the resistance measurement circuit for calculating resistance might be needed, it might combine with the configuration about a pin, and cost might become high.

[0006] This invention is made in view of the above-mentioned trouble in ink residue detection, and it aims at offering the ink jet recording apparatus and ink jet unit which the place made into the purpose is a simple configuration, and enable ink residue detection of low cost.

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## MEANS

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[Means for Solving the Problem] Therefore, the ink jet unit which formed in one the ink tank which stored the ink supplied to a head with memory and this head in this invention is used. In the ink jet recording device which records by breathing out ink from said head A read/write means to perform the writing or reading of data about ink consumption to the memory which a head has, This read/write means is characterized by having a residue detection means to detect the ink residue in an ink tank, based on the data about the ink consumption read from said memory.

[0008] Moreover, it is characterized by storing the data about ink consumption with which it is used with an ink jet recording device, and writing or reading is performed in the ink jet unit which formed in one the ink tank which stored the ink supplied to a head with memory, and this head when used for said memory with an ink jet recording device.

[0009] Since the data about ink consumption of the count of the regurgitation etc. are stored in the memory which a head has according to the above configuration, the information about the residue of the ink in an ink tank can be acquired by reading this data.

[0010]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained to a detail with reference to a drawing.

[0011] Drawing 3 is the mimetic diagram showing the internal configuration of the ink jet unit concerning 1 operation gestalt of this invention.

[0012] As shown in drawing, an ink jet unit forms a head 10 and the ink tank 14 in one, and it is equipped with this unit free [ attachment and detachment ] to carriage (un-illustrating). In drawing, 11 is a memory device, for example, EEPROM can constitute it. 12 is the PCB substrate with which the memory device 11 was attached, and the silicon substrate in which the exoergic resistor (un-illustrating) of plurality [ 13 ] was arranged corresponding to the number of ink deliveries, and the silicon substrate 13 and the PCB substrate 12 are electrically connected by wire bonding. 15 is a terminal for being prepared in the edge of the PCB substrate 12 and performing electrical installation by the side of a head and the body of equipment, and connects with the connector prepared on carriage with wearing on the carriage of an ink jet unit. A head 10 is constituted by each above element. On the other hand, the ink tank 14 stores the ink supplied to a head 10.

[0013] In the above configuration, the number of the driving pulses which show the count of the ink regurgitation, and the count of suction recovery are written in the memory device 11 in a head 10. That is, accumulation values, such as the number of driving pulses about the amount of ink consumed with a head 10, are memorized. Thereby, the ink residue of the ink tank 14 can be known.

[0014] In addition, although a memory device 11 may newly be formed in ink residue detection, the null part of the memory with which the head equips bit amendment from the first, for example can also be used for it, and, thereby, it can control further the increment in the cost for ink residue detection.

[0015] Drawing 4 is a flow chart which shows processing of reading/writing to the memory device 11 of the data about ink residues, such as record (printing) actuation and an above-mentioned driving pulse accompanying the actuation.

[0016] With this operation gestalt, processing is started by switching on a power source, and while storing in RAM of reading processing of the data in the memory 11 of the ink jet unit with which it is equipped at step S1, it asks for the data in which the current ink residue in the ink tank 14 is shown based on the read data. That is, the number of driving pulses read in memory 11 and the count of suction recovery action can be converted into the amount of ink consumed by them, and an ink residue can be known by subtracting from the value which shows the amount of ink of the beginning of the ink tank beforehand known in this value. Next, in step S2, it judges whether it is the following from a fixed value with the ink residue calculated the account of a top.

[0017] Here, when an ink residue judges more than as constant value, suction recovery action is performed at step S3, the count which is step S4 and was performed to the count of suction recovery of accumulation at step S3 is added, and the result is written in the memory 11 of a

head. That is, since fixed amount ink will be consumed if suction recovery is performed, while updating the residue data loaded in predetermined RAM of a control section, it performs writing the data in the memory 11 in a head. Next, based on the residue data updated at step S5, the same ink residue as step S2 is checked.

[0018] If it judges that it is the amount which an ink residue can still print at step S5, while printing 1 page at step S6, the number of driving pulses in the printing will be counted. And at step S7, while updating ink residue data by adding the number of driving pulses counted for 1 page to the accumulation pulse number in which it is stored in RAM, these data are written in the memory 11 in a head. In addition, specifically, the count of the number of driving pulses shown above can count the "on-" data of drive data with a predetermined counter. Moreover, similarly, whenever the count of recovery also processes, it is countable by incrementing the contents of the predetermined counter. Next, this procedure is ended when record of the last page was completed in step S9, and it judged whether it was record termination, when the same residue check as steps S2 and S5 was performed and the ink residue had not yet decreased at step S8, the processing same to processing of step S6 as return is repeated when having not ended, and it is judged that it ended.

[0019] On the other hand, by each of steps S2, S5, and S8, when a residue judges that there are few residues below with a predetermined value, in step S10, it stands by displaying a purport with few ink residues by the predetermined display of a printer, and being exchanged in an ink jet unit at step S11. Detection of having been equipped with a new ink jet unit carries out return and processing beyond step S1 mentioned above to processing of step S1.

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[0022] (in addition to this) In addition, especially this invention is equipped with means (for example, an electric thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used also in an ink jet recording method in order to make the ink regurgitation perform, and brings about the effectiveness which was excellent in the recording head of the method which makes the change of state of ink occur with said heat energy, and the recording device. It is because the densification of record and highly minute-ization can be attained according to this method.

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shape of a pulse form, since growth contraction of air bubbles will be performed appropriately instantly, the regurgitation of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable. As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed.

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[0025] Furthermore, this invention is effectively applicable also to the recording head of the full line type which has the die length corresponding to the maximum width of the record medium which can record a recording device. As such a recording head, any of the configuration which fills the die length with the combination of two or more recording heads, and the configuration as one recording head formed in one are sufficient.

[0026] In addition, this invention is effective also when the thing of a serial type like an upper example also uses the recording head fixed to the body of equipment, the recording head exchangeable chip type to which the electric connection with the body of equipment and supply of the ink from the body of equipment are attained by the body of equipment being equipped, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one.

[0027] Moreover, as a configuration of the recording device of this invention, since the effectiveness of this invention can be stabilized further, it is desirable to add the regurgitation recovery means of a recording head, a preliminary auxiliary means, etc. If these are mentioned concretely, a preheating means to heat using the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head, and a reserve regurgitation means to perform the regurgitation different from record can be mentioned.

[0028] Moreover, although only one piece was prepared also about the class thru/or the number of a recording head carried, for example corresponding to monochromatic ink, corresponding to two or more ink which differs in an others and record color or concentration, more than one may be prepared the number of pieces. That is, although not only the recording mode of only mainstream colors, such as black, but a recording head may be constituted in one as a recording mode of a recording device or the paddle gap by two or more combination is sufficient, for example, this invention is very effective also in equipment equipped with at least one of each of the full color recording mode by the double color color of a different color, or color mixture.

[0029] Furthermore, in addition, in this invention example explained above, although ink is

explained as a liquid It is ink solidified less than [ a room temperature or it ], and what is softened or liquefied at a room temperature may be used. Or by the ink jet method, since what carries out temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stabilization regurgitation range about the viscosity of ink, ink may use what makes the shape of liquid at the time of use record signal grant. In addition, in order to prevent the temperature up by heat energy positively because you make it use it as energy of the change of state from a solid condition to the liquid condition of ink, or in order to prevent evaporation of ink, the ink which solidifies in the state of neglect and is liquefied with heating may be used. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied also when using the ink of the property which will not be liquefied without grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when reaching a record medium. The ink in such a case is good for a porosity sheet crevice or a through tube which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the condition of having been held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0030] Furthermore, in addition, as a gestalt of this invention ink jet recording device, although used as an image printing terminal of information management systems, such as a computer, the gestalt of the reproducing unit combined with others, a reader, etc. and the facsimile apparatus which has a transceiver function further may be taken.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the mimetic diagram showing the configuration for the conventional ink residue detection in an ink tank.

[Drawing 2] It is drawing showing the equal circuit of the configuration for the conventional ink residue detection shown in drawing 1 .

[Drawing 3] It is drawing showing typically the internal configuration of the ink jet unit concerning 1 operation gestalt of this invention.

[Drawing 4] It is the flow chart which shows the procedure of the record actuation accompanied by the ink residue detection processing concerning 1 operation gestalt of this invention.

[Description of Notations]

10 Head

11 Memory

12 PCB Substrate

13 Silicon Substrate

14 Ink Tank

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平9-314861

(43) 公開日 平成9年(1997)12月9日

(51) Int.Cl. <sup>6</sup>	識別記号	庁内整理番号	F I	技術表示箇所
B 4 1 J	2/175		B 4 1 J	3/04
	2/05			1 0 2 Z
				1 0 3 B

審査請求 未請求 請求項の数 9 O L (全 6 頁)

(21) 出願番号 特願平8-141323

(22) 出願日 平成8年(1996)6月4日

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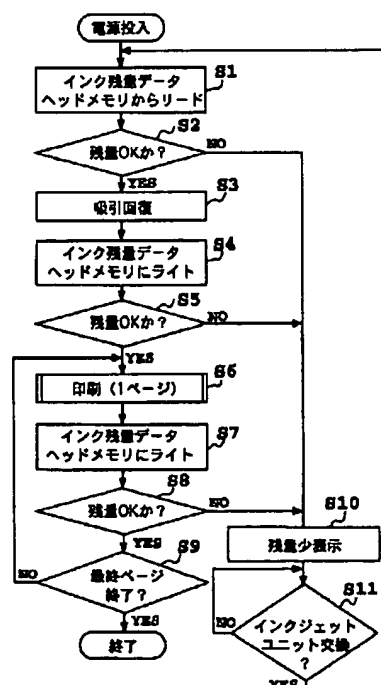
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(54) 【発明の名称】 インクジェット記録装置およびインクジェットユニット

(57) 【要約】

【課題】 インクジェット記録装置におけるインク残量検知のための構成を、簡易でかつ低コストなものとする。

【解決手段】 インクジェットヘッド内にインク残量に関するデータを格納するメモリを設け、装置の電源投入時に上記メモリからインク残量データを読み取り（ステップS1）、残量検知用のデータとする。そして吸引回復（ステップS3）や印刷（ステップS6）を行うごとにそれらの処理で消費したインク量を上記インク残量データが示す値から減算し、その結果を新たな残量データとするとともにヘッド内の上記メモリにそのデータを書き込む（ステップS4、S7）。以上のようにして得られるインク残量データが所定値以下となった場合、インク残量が少ない旨の表示を行う（ステップS10）。



#### 【特許請求の範囲】

【請求項1】 メモリを有したヘッドと該ヘッドに供給するインクを貯留したインクタンクとを一体に形成したインクジェットユニットを用い、前記ヘッドからインクを吐出して記録を行うインクジェット記録装置において、

ヘッドが有するメモリに対し、インク消費に関するデータの書き込みまたは読み取りを行うリード・ライト手段と、

該リード・ライト手段が前記メモリから読み出したインク消費に関するデータに基づき、インクタンクにおけるインク残量を検知する残量検知手段と、

を具えたことを特徴とするインクジェット記録装置。

【請求項2】 前記インク消費に関するデータは、インク吐出回数および吸引回復処理の回数であり、前記リード・ライト手段は、前記インク吐出回数および吸引回復処理の回数の累積値を前記メモリに書き込むことを特徴とする請求項1に記載のインクジェット記録装置。

【請求項3】 前記リード・ライト手段は、所定量の記録動作または吸引回復処理が終了する毎に、前記メモリへの書き込みを行うことを特徴とする請求項1または2に記載のインクジェット記録装置。

【請求項4】 前記インクジェット記録装置は、前記残量検知手段が、インク残量が所定量以下であることを検知したときは、残量が少ない旨の報知を行う報知手段をさらに具えたことを特徴とする請求項1ないし3のいずれかに記載のインクジェット記録装置。

【請求項5】 前記メモリは、他の情報の格納のために共用されるものであることを特徴とする請求項1ないし4のいずれかに記載のインクジェット記録装置。

【請求項6】 前記ヘッドは、熱エネルギーを利用してインクに気泡を生じさせ該気泡の生成に基づいてインクを吐出することを特徴とする請求項1ないし5のいずれかに記載のインクジェット記録装置。

【請求項7】 インクジェット記録装置で用いられ、メモリを有したヘッドと該ヘッドに供給するインクを貯留したインクタンクとを一体に形成したインクジェットユニットにおいて、

前記メモリには、インクジェット記録装置で用いられるときに書き込みまたは読み取りが行われる、インク消費に関するデータが格納されたことを特徴とするインクジェットユニット。

【請求項8】 前記インク消費に関するデータは、インク吐出回数および吸引回復処理の回数の累積値であることを特徴とする請求項7に記載のインクジェットユニット。

【請求項9】 前記ヘッドは、熱エネルギーを利用してインクに気泡を生じさせ該気泡の生成に基づいてインクを吐出することを特徴とする請求項7または8に記載のインクジェットユニット。

#### 【発明の詳細な説明】

##### 【0001】

【発明の属する技術分野】本発明は、インクジェット記録装置およびインクジェットヘッドに関し、詳しくは、インクジェットヘッドに供給するインクを貯留するためのインクタンクにおけるインク残量を検知するための構成に関するものである。

##### 【0002】

【従来の技術】従来より良く知られるインク残量検知のための構成は、インクタンク内に電極用の2本の針を挿入し、この2本の電極間のインク抵抗値を求めることにより、電極間のインクの有無を検出するものである。

【0003】図1はその従来例を示す模式図である。図において、32はインクタンクを示し、その内部には吸収体が吸収されており、吸収体にはインク31が充填されている。1対の電極33は、インクタンク32のケースをなす部材を貫いて設けられている。各電極33にはリード線が接続し、これにより記録装置本体における所定の電源、電流検知構成等により、図中、A、Bで示す電極間に定電圧（もしくは定電流）を印加し、その時に生ずるA、B間の電流（もしくは電圧）を検出してインク抵抗値を知り、それによって最終的にインク残量を求めるものである。

【0004】図2は上述した従来例に係るインク残量検知構成の等価回路を示す図である。電源41によって所定電圧が印加される電極A、B間にはインクの量に応じた抵抗値を示す抵抗 $R_i$ が存在し、その抵抗 $R_i$ の値をもってインク残量の判断を行うことができる。

##### 【0005】

【発明が解決しようとする課題】しかしながら、上記従来例では、電極間に存在するインクの抵抗値を測定しているため、インクの種類によってその抵抗値が異なる場合、測定の結果得られる残量にばらつきを生じたり、また、電極用ピンを挿入することに起因したインクタンク組立上の種々の制約が生じることがある。さらに、抵抗値を求めるための抵抗測定回路が必要となり、ピンに関する構成と併せてコストが高くなることもあった。

【0006】本発明は、インク残量検知における上記問題点に鑑みてなされたものであり、その目的とするところは簡易な構成であり、かつ低コストのインク残量検知を可能とするインクジェット記録装置およびインクジェットユニットを提供することを目的とする。

##### 【0007】

【課題を解決するための手段】そのために本発明では、メモリを有したヘッドと該ヘッドに供給するインクを貯留したインクタンクとを一体に形成したインクジェットユニットを用い、前記ヘッドからインクを吐出して記録を行うインクジェット記録装置において、ヘッドが有するメモリに対し、インク消費に関するデータの書き込みまたは読み取りを行うリード・ライト手段と、該リード

・ライト手段が前記メモリから読み出したインク消費に関するデータに基づき、インクタンクにおけるインク残量を検知する残量検知手段と、を具えたことを特徴とする。

【0008】また、インクジェット記録装置で用いられ、メモリを有したヘッドと該ヘッドに供給するインクを貯留したインクタンクとを一体に形成したインクジェットユニットにおいて、前記メモリには、インクジェット記録装置で用いられるときに書き込みまたは読み取りが行われる、インク消費に関するデータが格納されたことを特徴とする。

【0009】以上の構成によれば、ヘッドが有するメモリに吐出回数等のインク消費に関するデータが格納されるので、このデータを読み取ることにより、インクタンクにおけるインクの残量に関する情報を得ることができる。

【0010】

【発明の実施の形態】以下、図面を参照して本発明の実施形態を詳細に説明する。

【0011】図3は本発明の一実施形態に係るインクジェットユニットの内部構成を示す模式図である。

【0012】図に示すように、インクジェットユニットはヘッド10とインクタンク14とを一体に形成したものであり、このユニットは、キャリッジ（不図示）に対し着脱自在に装着される。図において、11はメモリ素子であり、例えばEEPROMによって構成することができる。12はメモリ素子11が取付けられたPCB基板、13は複数の発熱抵抗体（不図示）がインク吐出口の数に対応して配設されたシリコン基板であり、シリコン基板13とPCB基板12はワイヤーボンディングにより電気的に接続されている。15はPCB基板12の端部に設けられヘッドと装置本体側との電気的接続を行うための端子であり、インクジェットユニットのキャリッジへの装着にともなって、キャリッジ上に設けられたコネクタと接続する。以上の各要素によってヘッド10が構成される。一方、インクタンク14は、ヘッド10に供給するインクを貯留するものである。

【0013】以上の構成において、ヘッド10内のメモリ素子11にはインク吐出の回数を示す駆動パルスの数および、吸引回復処理の回数を書き込まれる。すなわち、ヘッド10で消費されるインク量に関する駆動パルス数等の累積値が記憶される。これにより、インクタンク14のインク残量を知ることができる。

【0014】なお、メモリ素子11は、インク残量検知用に新たに設けてもよいが、例えばビット補正用にもともとヘッドが具えているメモリの空白部分を利用することもでき、これによりインク残量検知のためのコストの増加をさらに抑制することができる。

【0015】図4は記録（印刷）動作およびその動作に伴う上述の駆動パルス等、インク残量に関するデータ

のメモリ素子11に対する読み取り／書き込みの処理を示すフローチャートである。

【0016】本実施形態では、電源が投入されることにより処理が起動され、ステップS1で、装着されているインクジェットユニットのメモリ11内のデータを読み取り処理のRAM内に格納するとともにその読み取ったデータに基づいてインクタンク14内の現在のインク残量を示すデータを求める。すなわち、メモリ11から読み取った駆動パルス数および吸引回復動作の回数をそれらによって消費されるインク量に換算し、この値を予め知られているインクタンクの最初のインク量を示す値から減算することによりインク残量を知ることができる。次に、ステップS2において、上記求めたインク残量がある一定の値より以下か否かを判断する。

【0017】ここで、インク残量が一定値以上と判断した場合は、ステップS3で吸引回復動作を行い、ステップS4で、累積の吸引回復回数にステップS3で行った回数を加算し、その結果をヘッドのメモリ11に書き込む。すなわち、吸引回復を行うと一定の量インクが消費されるため、制御部の所定のRAM内にロードされてある残量データを更新するとともにそのデータをヘッド内のメモリ11に書き込むことを行う。次に、ステップS5で更新された残量データに基づき、ステップS2と同様のインク残量のチェックを行う。

【0018】ステップS5で、インク残量が未だ印刷できる量であると判断すると、ステップS6で1ページ分の印刷を行うとともにその印刷における駆動パルス数をカウントする。そしてステップS7では、1ページ分のカウントした駆動パルス数を、RAM内に格納される累積パルス数に加算することによりインク残量データを更新するとともに、同データをヘッド内のメモリ11に書き込む。なお、以上示した駆動パルス数のカウントは、具体的には、例えば駆動データの“オン”データを所定のカウンタによってカウントすることができる。また、回復処理の回数も同様に、処理を行うごとに所定のカウンタの内容をインクリメントすることによってカウントすることができる。次に、ステップS8で、ステップS2、S5と同様の残量チェックを行い、インク残量が未だ少なくなっていない場合には、ステップS9において、最終ページの記録が終了して記録終了か否かを判断し、終了していない場合はステップS6の処理に戻り同様の処理を繰り返し、終了したと判断した場合は本処理手順を終了する。

【0019】一方、ステップS2、S5およびS8のそれぞれで、残量が所定値以下で残量が少ないと判断した場合は、ステップS10において、プリンタの所定の表示部でインク残量が少ない旨の表示を行い、ステップS11でインクジェットユニットが交換されるのを待機する。新たなインクジェットユニットが装着されたことを検知すると、ステップS1の処理に戻り、ステップS1



以上の上述した処理を行う。

【0020】なお、以上の実施形態の説明において、プリンタの機械的構成等の説明を省略したが、以上で説明した以外の構成については公知のものをを用いることができることは勿論である。

【0021】また、上記実施形態においては、メモリ11を基板12に外付けで設けるようにしたが、例えばシリコン基板13に発熱抵抗体や電極等を形成するのと同様のプロセスでシリコン基板内に形成するようにしてもよい。

【0022】（その他）なお、本発明は、特にインクジェット記録方式の中でも、インク吐出を行わせるために利用されるエネルギーとして熱エネルギーを発生する手段（例えば電気熱変換体やレーザ光等）を備え、前記熱エネルギーによりインクの状態変化を生じさせる方式の記録ヘッド、記録装置において優れた効果をもたらすものである。かかる方式によれば記録の高密度化、高精細化が達成できるからである。

【0023】その代表的な構成や原理については、例えば、米国特許第4723129号明細書、同第4740796号明細書に開示されている基本的な原理を用いて行うものが好ましい。この方式は所謂オンデマンド型、コンティニュアス型のいずれにも適用可能であるが、特に、オンデマンド型の場合には、液体（インク）が保持されているシートや液路に対応して配置されている電気熱変換体に、記録情報に対応して核沸騰を越える急速な温度上昇を与える少なくとも1つの駆動信号を印加することによって、電気熱変換体に熱エネルギーを発生せしめ、記録ヘッドの熱作用面に膜沸騰を生じさせて、結果的にこの駆動信号に一つ一つに対応した液体（インク）内の気泡を形成できるので有効である。この気泡の成長、収縮により吐出用開口を介して液体（インク）を吐出させて、少なくとも1つの滴を形成する。この駆動信号をパルス形状とすると、即時適切に気泡の成長収縮が行われるので、特に応答性に優れた液体（インク）の吐出が達成でき、より好ましい。このパルス形状の駆動信号としては、米国特許第4463359号明細書、同第4345262号明細書に記載されているようなものが適している。なお、上記熱作用面の温度上昇率に関する発明の米国特許第4313124号明細書に記載されている条件を採用すると、さらに優れた記録を行うことができる。

【0024】記録ヘッドの構成としては、上述の各明細書に開示されているような吐出口、液路、電気熱変換体の組合せ構成（直線状液流路または直角液流路）の他に熱作用部が屈曲する領域に配置されている構成を開示する米国特許第4558333号明細書、米国特許第4459600号明細書を用いた構成も本発明に含まれるものである。加えて、複数の電気熱変換体に対して、共通するスリットを電気熱変換体の吐出部とする構成を開示

する特開昭59-123670号公報や熱エネルギーの圧力波を吸収する開孔を吐出部に対応させる構成を開示する特開昭59-138461号公報に基いた構成としても本発明の効果は有効である。すなわち、記録ヘッドの形態がどのようなものであっても、本発明によれば記録を確実に効率よく行うことができるようになるからである。

【0025】さらに、記録装置が記録できる記録媒体の最大幅に対応した長さを有するフルラインタイプの記録ヘッドに対しても本発明は有効に適用できる。そのような記録ヘッドとしては、複数記録ヘッドの組合せによってその長さを満たす構成や、一体的に形成された1個の記録ヘッドとしての構成のいずれでもよい。

【0026】加えて、上例のようなシリアルタイプのもので、装置本体に固定された記録ヘッド、あるいは装置本体に装着されることで装置本体との電気的な接続や装置本体からのインクの供給が可能になる交換自在のチップタイプの記録ヘッド、あるいは記録ヘッド自体に一体的にインクタンクが設けられたカートリッジタイプの記録ヘッドを用いた場合にも本発明は有効である。

【0027】また、本発明の記録装置の構成として、記録ヘッドの吐出回復手段、予備的な補助手段等を付加することは本発明の効果を一層安定できるので、好ましいものである。これらを具体的に挙げれば、記録ヘッドに対してのキャッピング手段、クリーニング手段、加圧或は吸引手段、電気熱変換体或はこれとは別の加熱素子或はこれらの組み合わせを用いて加熱を行う予備加熱手段、記録とは別の吐出を行なう予備吐出手段を挙げることができる。

【0028】また、搭載される記録ヘッドの種類ないし個数についても、例えば単色のインクに対応して1個のみが設けられたものの他、記録色や濃度を異にする複数のインクに対応して複数個数設けられるものであってもよい。すなわち、例えば記録装置の記録モードとしては黒色等の主流色のみの記録モードだけではなく、記録ヘッドを一体的に構成するか複数個の組み合わせによるかいずれでもよいが、異なる色の複色カラー、または混色によるフルカラーの各記録モードの少なくとも一つを備えた装置にも本発明は極めて有効である。

【0029】さらに加えて、以上説明した本発明実施例においては、インクを液体として説明しているが、室温やそれ以下で固化するインクであって、室温で軟化もしくは液化するものを用いてもよく、あるいはインクジェット方式ではインク自体を30℃以上70℃以下の範囲内で温度調整を行ってインクの粘性を安定吐出範囲にあるように温度制御するものが一般的であるから、使用記録信号付与時にインクが液状をなすものを用いてもよい。加えて、熱エネルギーによる昇温を、インクの固形状態から液体状態への状態変化のエネルギーとして使用せしめることで積極的に防止するため、またはインクの蒸発

を防止するため、放置状態で固化し加熱によって液化するインクを用いてもよい。いずれにしても熱エネルギーの記録信号に応じた付与によってインクが液化し、液状インクが吐出されるものや、記録媒体に到達する時点ではすでに固化し始めるもの等のような、熱エネルギーの付与によって初めて液化する性質のインクを使用する場合も本発明は適用可能である。このような場合のインクは、特開昭54-56847号公報あるいは特開昭60-71260号公報に記載されるような、多孔質シート凹部または貫通孔に液状又は固形物として保持された状態で、電気熱変換体に対して対向するような形態としてもよい。本発明においては、上述した各インクに対して最も有効なものは、上述した膜沸騰方式を実行するものである。

【0030】さらに加えて、本発明インクジェット記録装置の形態としては、コンピュータ等の情報処理機器の画像出力端末として用いられるものの他、リーダ等と組合せた複写装置、さらには送受信機能を有するファクシミリ装置の形態を探るもの等であってもよい。

【0031】

【発明の効果】以上の説明から明らかなように、本発明

によれば、ヘッドが有するメモリに吐出回数等のインク消費に関するデータが格納されるので、このデータを読み取ることにより、インクタンクにおけるインクの残量に関する情報を得ることができる。

【0032】この結果、簡易かつ低コストな構成でインク残量検知を行うことができる。

【図面の簡単な説明】

【図1】インクタンクにおける従来のインク残量検知のための構成を示す模式図である。

【図2】図1に示す従来のインク残量検知のための構成の等価回路を示す図である。

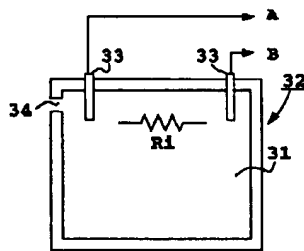
【図3】本発明の一実施形態に係るインクジェットユニットの内部構成を模式的に示す図である。

【図4】本発明の一実施形態に係るインク残量検知処理を伴う記録動作の手順を示すフローチャートである。

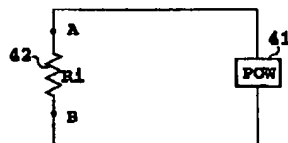
【符号の説明】

- 10 ヘッド
- 11 メモリ
- 12 PCB基板
- 13 シリコン基板
- 14 インクタンク

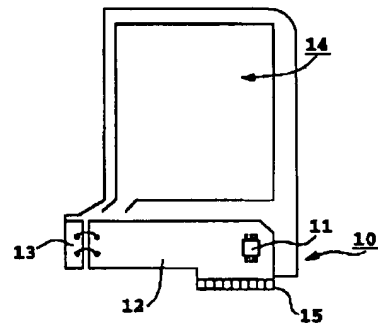
【図1】



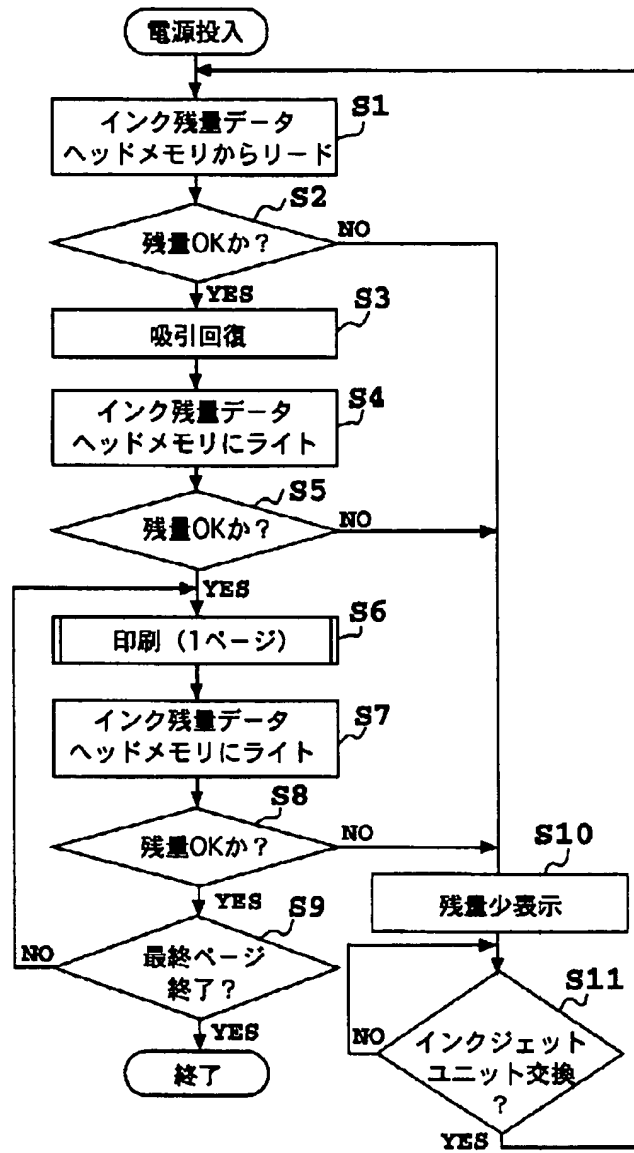
【図2】



【図3】



【図4】



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